

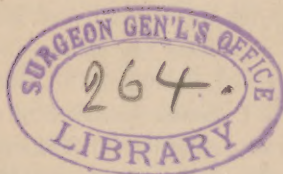
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ON THE
NEPHILA PLUMIPES, OR SILK SPIDER.

BY BURT G. WILDER, S. B.,

LATE SURGEON OF THE 55TH MASS. VOLS.

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On the Nephila Plumipes, or Silk Spider. By BURT G. WILDER, S. B., late Surgeon 55th Mass. Vols.

AT the north end of Folly Island, which lies just south from the harbor of Charleston, S. C., on the 20th of August, 1863, I found in a tree a large and very handsome geometrical spider, whose web was about three feet in diameter. While examining the insect at my tent, it occurred to me to see how much of the silken thread could be drawn from the spinners. As it was not disturbed by pulling out a few yards, I wound the thread around a quill, and then, by turning this in my fingers, reeled off silk from the body of the spider for one hour and a quarter, at the rate of six feet per minute, making one hundred and fifty yards of most beautifully shining golden silk. This specimen is still in my possession, and, having been removed from the quill, weighs one third of a grain. I had never before seen this spider, nor had I ever heard of this method of obtaining a silken material; but when, during the following summer, another officer of our regiment* described to me a large spider as very common upon Long Island, which lies just west from Folly Island, I knew it was the same, and told him what I had done, adding that I was sure something would come of it in time. By substituting a cylinder worked by a handle for mine turned in the fingers, this officer obtained more of the silk, winding it upon rings of hard rubber, and afterward, by using a "gear-drill stock," another officer† accomplished similar results still more rapidly.

With this "gear-drill stock" I wound from a number of spiders *three thousand four hundred and eighty yards* of silk upon the periphery and over the sides of a hard rubber ring; the length being accurately measured by multiplying the dimensions of the ring where wound upon by the number of revolutions per minute, and this product by the number of minutes of actual winding. This was in the fall of 1864, and in February, 1865, I showed specimens of the spider and of the silk to Professors Wyman, Agassiz, and Cooke of Harvard University, neither of whom had ever heard of this way of obtaining silk, nor, with the exception of Professor Wyman, — who found a single individual among some specimens collected at the South, — had they ever seen the insect. At this time, too, a friend‡ to whom the whole history of the

* Major Sigourney Wales, 55th Massachusetts Volunteer Infantry.

† Lieut.-Col. Charles B. Fox, 55th Massachusetts Volunteer Infantry.

‡ Dr. William Nichols of Boston.

matter was known, expressed his confident belief that this new silken product could be made of some practical utility, especially in view of the anticipated scarcity of ordinary silk ; and it is in great measure due to his advice and assistance that the experiments and investigations recounted below have been made.

The only mention of this spider is in the German work of C. L. Koch, "Die Arachniden," where in Vol. VI. is described, under the name of *Nephila plumipes*, a mutilated female specimen, the only one ever collected, and which is preserved in the museum of J. Sturm at Nuremberg. This description and its accompanying figure are very imperfect, but until a careful comparison can be made between the original specimen and some of my own, I will consider the latter as representatives of *N. plumipes*; though an accurate description and figure shall be made as soon as possible.

The following general description applies only to the females, the males being very small and of a different color.

NEPHILA (PLUMIPES?) Koch. A large and very elegant species of *Nephila*, resembling most of its congeners in the general form of the body, and, like *N. clavipes* and *N. fasciculata*, possessing peculiar collections of stiff hairs upon the legs, but differing from these two species in that these hairs are more closely set so as to justify the German term "Haarbürste" (Hair-brushes).

In general the cepalo-thorax is black above, but covered, except in spots, by silver-colored hairs. The abdomen is olive-brown, variously marked with yellow and white spots and stripes. On the first, second, and fourth pair of legs are one or two brushes of stiff black hairs pointing outward away from the body. The length of the body is one and one tenth inches, and the spread of the legs from two and three fourths in a lateral, to three and three fourths inches in a longitudinal direction. The length of the body of the male is about one third of an inch, and his general color is brown. His palpi are clubbed near the extremities, and end in a sharp point turning outward.

With the exception of the first and only specimen discovered upon Folly Island, and a cocoon found on James Island, I have met with this spider only upon Long Island and one or two similar bits of land in the vicinity. They are all low, sandy, and marshy, covered with palmetto and pine trees, uninhabited, and apparently never before visited by naturalists.

These spiders are specially abundant upon Long Island, and are

found in large geometrical webs, two, three, or four feet in diameter, stretched between shrubs or trees, and often high up among the pines, so as to be out of reach. The webs are strong and of a yellow color; and, as with most species of geometrical spiders, the concentric circles are elastic and studded with numerous viscid globules, while the radii and other parts of the framework are composed of dry and inelastic silk; but with this species the distinction between these two portions of the web consists not only in the viscosity of the former, but also in the color; for while most of the concentric circles are of a bright yellow or golden hue, the radii and stay-lines, and also *every eighth or tenth circle* (the number varies in different individuals), are white or silver-colored. The circles are very near together in proportion to the size of the insect, being only one third or one fourth of an inch apart.

As might be inferred from these facts, but which, so far as I know, has never before been observed, this spider not only has the power of regulating the *size* of its thread, — according as one or two, or three or four of its spinnerets are pressed upon the surface from which the line is to extend, or as a greater or less number of the spinnerules in any one spinneret are employed, — but can also use in the construction of its web either the white or the yellow silk at will; for of its two principal pairs of spinnerets, one, the anterior, yields the yellow, while the other or posterior pair yields the white silk. Of this I satisfied myself by carrying the thread from the anterior pair of spinners upon one part of a spindle, and that from the posterior pair upon another part, guiding them with pins while the spindle was in motion; the result being the formation of two circles of silk, one of a golden, the other of a silver color, as in one of the specimens exhibited; moreover, if while both threads are being drawn out, they are slackened, the lower silver thread will wrinkle and fly up, being inelastic; while the other will contract and, within certain limits, preserve its direction.

There is a corresponding difference in the color of the glands which secrete the gum of which the silk is formed; one set, the more numerous, being yellow, and the other white.

The manner in which the spider deposits the globules of gum on the circles which she wishes to be viscid is not yet explained; at any rate this same yellow silk, when either reeled from the body of the spider, or when employed in the formation of its cocoon, is *dry* and *much less elastic* than that of which the concentric circles are composed.

The evolution of the silk from the spider is almost wholly a mechan-

ical process, and, beyond a certain expansion of the parts, by separating the spinners from each other, the only control exercised by the insect is by means of its hinder legs, the tips of which serve to guide the thread, and by grasping it to control the evolution. I have never been able to reel out over three hundred yards at once from a single spider; but on opening the abdomen, the glands are found still to contain more or less gum. Upon three successive days I obtained equal quantities of silk; so that if, as now seems probable, the emission of the silk is purely mechanical, then a certain degree of preparation is necessary, after it is secreted, before it is ready for use.

The diameter of the silk as spun by the insect, or as reeled from it, varies from one six-thousandth to one thousandth of an inch;* it is exceedingly strong, more so in proportion to its bulk than that of the silk-worm; as is natural, since the spider's thread is made up of hundreds and even thousands of minute fibrils, while the common silk is single. The largest threads are those composing the outer layer of the cocoons, but these are evidently compound, and each of the two, three, or four strands is apparently such as proceeds from the single spinners; the minute fibrils of which have united at once on leaving the spinnerules, so as to form the ordinary silken fibre which generally appears simple under the microscope.

The habits of this spider are very interesting. It seems to obey three principal instincts: first, to ascend; second, to seek the light, whether natural or artificial; and, third, to maintain a position with the head downward. It has eight eye-spots, but, so far as I have observed, it can only distinguish light from darkness, and is not able to see objects. There is not here space to give in detail an account of all that I observed in case of several which made their webs in my room in South Carolina; but all seems to indicate that these spiders do not *see*, as the term is generally understood; the touch is, however, very acute, and is exercised by the palpi and by the tips of the legs, specially the anterior pair. Unlike some other geometrical spiders, it seizes its prey at once in its jaws, and never envelopes it in a silken net till it has expired. The sense of hearing is evidently very acute.

It is very quiet in its disposition, and never leaves its web unless molested. The female builds the web, and even carries the male on her back or belly when moving about; she never attempts to bite

* The micrometer measurements were made by Mr. R. C. Greenleaf.

unless provoked, and may be suffered to run over one's person with impunity.

Perhaps the most remarkable fact in connection with this spider is, that it can be *fed and watered by hand*; a live fly held to its jaws is seized as soon as a buzz makes its presence known; so also a bit of chicken-liver, if touched to the jaws; and if a drop of water be presented on a camel's-hair pencil, it will be readily taken and gradually swallowed. It is evident that the spiders drink the drops of water which are left in the web from the rain or dew; and they thrive best in a moist atmosphere.

The female lays four or five hundred eggs, half as large as a pin's head, and slightly agglutinated together in a rounded mass, which is secured on the lower side of a leaf by a strong silken cocoon of loose texture, and varying in color. Many of the eggs which were laid by my spiders in September were hatched in about thirty days. The young differ much from the adult in form and color; and the changes which they pass through in growth will prove a most interesting branch of the subject. The young do not leave the cocoon for some time; and even after they have, are more or less gregarious, — always keeping in companies, and preserving good order while moving. They need water, and, if not supplied with food, are prone to eat one another. If properly attended to, they grow quite rapidly;* and although at first they make only an irregular web in common, yet after they have attained a length of half an inch, they will, if separated, construct regular geometrical webs.

In a state of nature, not many over one per cent of the spiders which are hatched live to maturity; so that the question of a practical value of this silk depends upon the success of the attempts to prevent this destruction, which is apparently due to their own voracity, to the elements, and to other insects.

Much more might be related concerning the habits of the insect, of the manner of keeping and feeding the young, of the means of securing the spider while its silk is obtained, and of the various apparatus employed; but I am so impressed with the peculiarities thus far observed in themselves, and with the beauty and strength of the silk, that if time and means permit I shall continue the inquiry as far as possible. And having now, as I hope, established my claim to the

* Feb. 23d, 1866. Some of these young are now more than an inch in length.

discovery of this new method of obtaining a silken material, (namely, by a reeling or circular motion applied to the insect itself,) I will defer to a future occasion a more complete account of the spider, of its habits, anatomy, and embryology, and of the various qualities of its silk, with whatever conclusion can be reached concerning the practicability of rearing the young; and, also, how far it is possible to apply the same process to the silk-worm, and other silk-producing larvæ.

